Should control expenditure on Noogoora Burr in the Kimberley be drastically reduced

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Executive Summary: A successful control effort minimising the number of flowering plants by treating extensive areas of Noogoora burr in the Kimberley has been conducted over the last twenty-two years. The objective to keep Noogoora burr from establishing in the southern sheep raising areas has been achieved. The project is being conducted to benefit the Western Australian wool industry by minimising the possibility of Noogoora burr fault. The control effort minimised the number of flowering plants by treating extensive areas of the weed. There has not been a Noogoora burr plant found in either the southern pastoral areas or the sheep areas of the south west that may have originated from the Kimberley. The few plants that have occurred over the years have been more likely to have originated from burr that entered WA with stock and or bedding. The vast majority of burr is intercepted during routine stock and vehicle inspections at the Quarantine Checkpoints.

Control costs have increased over many years as funds became available to treat larger areas of burr. At the 1995/96 level of expenditure the benefit cost ratio is much less than one to one. Control costs for 1996/97 have been reduced from $800,000 to $340,000 per annum. Even with this substantially reduced program the ratio of benefits to costs is close to one. The reduced control effort will continue to provide industry protection but this will also be reduced. With a substantial change in control operations it would be useful to review this analysis in three years. The way that Noogoora burr develops in that time and possibly spreads to new areas in the Kimberley will provide more information on the increased risk of burr being transported south.

A previous in depth study by Roberts *et al*, 1988 and a re-assessment two years ago (pers. comm., A Young, 1994) produced higher benefit cost ratios due to the assumptions used which included lower containment costs in the Kimberley, higher expectations of the project's ability to reduce the area of burr and greater expectations of the losses that burr would cause to WA's sheep industry than has occurred in this analysis.

Background

Noogoora burr has been established in the Kimberley region of WA since at least 1974 when it was first reported along approximately 19 kilometres of both banks of the Ord River. It was probably present for a number of years prior to its discovery. In 1974 it was anticipated that Noogoora burr could be eradicated with a concerted effort. Some of the seed has a dormancy factor which meant that an eradication campaign had to be conducted over at least three years and probably longer, with no flowering, to be certain that it was successful.

A second larger infestation of Noogoora burr was found on the Fitzroy River in April 1982. Periodic flooding of the Fitzroy River spread Noogoora burr seed from the weed source near Fitzroy Crossing to the sea at King Sound, south of Derby. As finances were limited it was decided to work upstream, controlling the burr and ensuring it did not spread away from the river frontage. It was recognised at the time that eradication was not possible with limited funds (pers. comm., C Johnstone, 1996). The containment objective was to minimise the possibility of Noogoora burr leaving

the Kimberley and infesting sheep country further south. The weed had invaded very difficult terrain amongst the river channels and flood plain.

Biological control agents, the stem-galling moth, *Epiblema strenuana*, and the rust fungus, *Puccinia xanthii*, have been released. Epiblema is established along the lower Ord River and significantly affects some Noogoora burr plants which are stunted and stressed by the effects of the moth. The rust has had much less impact than the moth. It seems night time temperatures in the north may be too high in the Noogoora burr growing season for the rust to be effective. The stem-galling moth has been released and survived for a season along the Fitzroy River but has not been found in the following year (P. Stubbs, 1995). The Ord River area, where the moth survives, has green Noogoora burr for a much longer period than the Fitzroy which may be the reason for the lack of survival of the moth in the Fitzroy River valley (pers. comm., P. Stubbs, 1996).

The containment strategy to minimise the possibility of burr leaving the Kimberley was to destroy as many of the growing plants as possible. The containment strategy also relied on a thorough quarantine and inspection procedure and an innovative extension campaign. Coloured leaflets were widely circulated and a concept of public access areas was introduced. These areas were kept free from Noogoora burr plants, although there are many burr on the ground as well as in the river, to minimise the possibility of the public inadvertently carrying burr away from the infested areas. As well as controlling large areas of burr to minimise seed set, cattle inspections were continued to ensure cattle leaving quarantined properties in the Kimberley were checked for burr and any burr found was removed.

A decreased area of burr will decrease the number of cattle carrying burr necessitating reduced hand picking during the routine inspections of stock leaving the Kimberley. In 1995, 112 burr were removed from 31 cattle of over six thousand inspected (pers. comm., P Stubbs, 1996). The amount of burr, on cattle due to be transported south, is expected to increase from 1997 as the containment project will allow more burr to grow with an increase both in the number of cattle contaminated and the number of burr carried as a result of a reduced budget allocation (pers. comm., P Stubbs, 1996). The possibility of burr being missed will increase as the number of burr on cattle increases although burr will continue to be hand picked from cattle carrying burr before they are transported south. The change from shorthorn cattle to Brahman, that has been adopted by much of the Kimberley cattle industry, has assisted the project as Brahman cattle are less likely to carry burr in their coats than the shorthorn cattle.

The infestations at Halls Creek will be controlled because they are close to eradication. If those infestations were left, more cattle would become exposed to burr over a large area in the Halls Creek shire. At this stage it is better to continue the eradication of those areas than to leave the weed and increase the number of infested cattle and consequent increased probability of burr moving south. The control of the Fitzroy River infestations will be limited to public access areas (including a one hundred metre buffer) and river crossings. This will reduce the possibility of the camping and fishing public inadvertently collecting and carrying burr south to the sheep grazing areas of the southern rangeland and the south-west (pers. comm., P Stubbs, 1996). However this

possibility will increase from 1997 as the major seed beds upstream will have a reduced amount of control.

Table 1 Sensitivity analysis

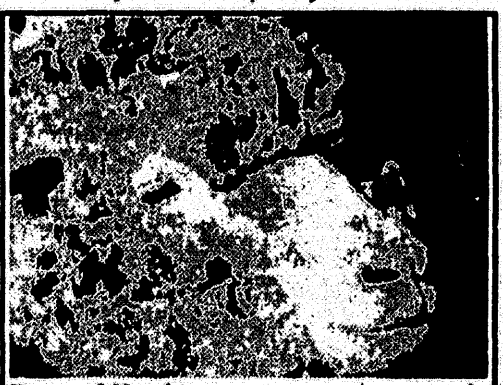
Assumption	Data Source	Best Bet Value	Minimum	Maximum	BCR
Degree of burr fault of wool from the wheat/sheep belt	Bob Martin (NSW Agriculture Orange)	Zero	Zero	0.2% of sheep to have burr fault (50,000)	1.0 - 1.2
Degree of burr fault of wool from the south-west	Bob Martin (NSW Agriculture Orange)	Zero	Zero	0.5% of sheep to have burr fault (30,000)	1.0 - 1.2
Number of pastoral sheep affected	Bob Martin (NSW Agriculture Orange)	500,000	200,000	1 million	0.5 - 2.0
Cost of the burr fault	Gail Bessen (APB)	50c per kg	40c per kg	75c per kg	0.8 - 1.5
Affect on the Kimberley river country carrying capacity	Peter Stubbs, Richard Watkins and Paul Novelly (Kununurra)	40,000 ha	20,000 ha	60,000 ha	1.1 - 1.3
Without the control project Noogoora burr control costs would occur in the sheep areas annually.	Peter Stubbs and Richard Watkins (Kununurra)	$50,000	$25,000	$100,000	1.1 - 1.4

Pest potential of Noogoora burr

i) The wool industry

Noogoora burr is a particularly aggressive plant. It can completely smother all ground level native vegetation and feed along water courses in pastoral areas so that the carrying capacity is lowered. Once a pastoral property becomes heavily infested with the burr the only alternative is to graze cattle, which can forage the remaining feed (Tideman, 1964). Although the cotyledons are toxic to stock, cattle are less likely than sheep to be poisoned because they don't graze as close to the ground as sheep. The Kimberley infestation is in a cattle grazing area.

The burrs ... are of great importance to the Australian wool industry. The burr becomes entangled in wool and are a problem to shearers when they have worked into the fleece and are struck by the shearing combs. They often completely mat the wool particularly under the neck and on the belly, and seriously damage carding machines. Burrs cannot be removed mechanically and the wool must be carbonised with acid which imposes a high additional cost on wool production (Parsons and Cuthbertson, 1992). Wool contaminated by burr is commonly reduced in value by up to 50 cents per kilogram greasy (pers. comm., Gail Bessen, 1996). Heavy amounts of burr along the belly have also been known to cause rams to neglect mating (pers. comm., Alec Holm, 1996).



Burrs of *Xanthium* spp. contaminate wool from Parsons and Cuthbertson , 1992

Noogoora burr is a summer annual dependent on summer rains for germination, and dense infestations occur throughout the hot summer-rainfall climates of coastal and western Queensland and northern New South Wales (Wapshere, 1974a). The Australian Wool Board, from records of the source of each bale sold, supplied separate figures of the percentage and number of bales of wool contaminated by this burr in each wool area in Queensland and New South Wales. Averages of the yearly percentages of infested bales were calculated for each wool area and mapped on to eastern Australia as shown in Fig. 1 (Wapshere, 1974b).

Alchin estimated that in 1976 about 10% of wool from the Western Division of New South Wales received price penalties of 5 cents per kg due to contamination by Noogoora burr. This estimate is a reflection of the spread of Noogoora burr in western NSW following the 1973-76 floods (Martin & Carnahan, 1982). This evidence was used when developing the assumptions about the expected infestations of sheep in Western Australia's southern rangeland. The assumptions about potential contamination used in this analysis were less than those assumptions used in either the Roberts *et al*, 1983 study or the Young 1994 study which produced higher benefit cost ratios than this study.

The seeds and seedlings are poisonous to animals. The poison persists in the cotyledons, hence the seedling stage is the most dangerous. After summer rains, burr seedlings appear in large numbers and then animals are at greater risk if these are grazed heavily. Poisoning seems less common in Australia than in North America where sheep, horses, pigs and poultry are frequently lost. Mature plants are not usually eaten because of the rough texture of the leaves but graziers claim they have some value in times of drought (Parsons and Cuthbertson, 1992).

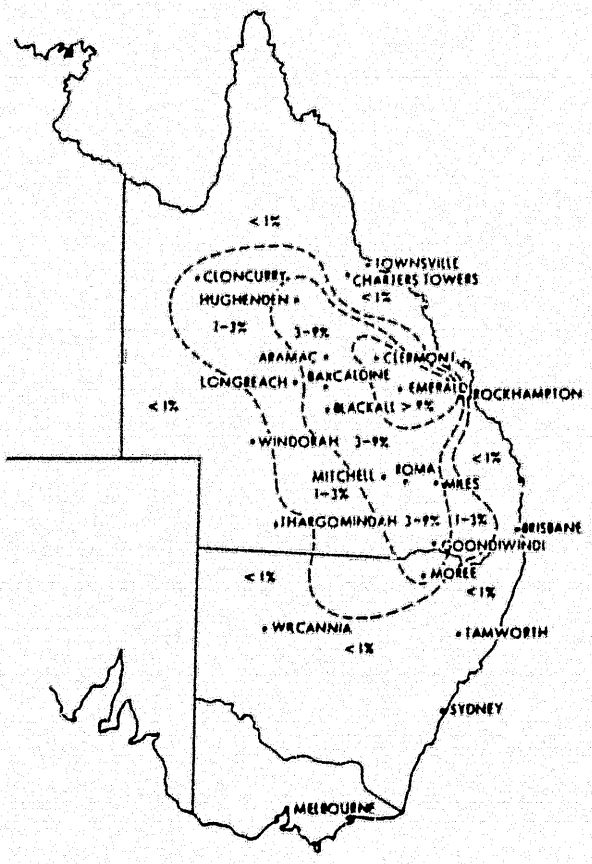


Fig. 1. Zones of eastern Australia with various levels of Noogoora burr fault in wool.

ii) The cattle industry

Noogoora burr displaces better pasture species in the Kimberley river systems that incurs a cost to the grazing system. Along the banks of creeks, rivers and water holes and under the drip lines of trees Noogoora burr is expected to become a monoculture. Noogoora burr could quickly develop heavy infestations over the 270,000 ha where it currently exists (pers. comm., P. Stubbs and R. Watkins, 1996). However it is estimated that only 7.5% (about 20,000 ha) of that riparian land would cause significant losses to the Kimberley cattle industry. A gross margin of $4.50 for cattle in that area was used in the calculation of expected losses (pers. comm,. P. Novelly, 1996).

Another 7.5% of that riparian land would have heavy infestations but, as those areas are recommended to be excluded from grazing, they were not included in the expected losses to the cattle industry. That area can be a wildlife corridor and has special conservation values. The areas close to the water are also the prime recreational areas (pers. comm,. P. Novelly, 1996).

There may be a reduced market for cattle from quarantine areas as discerning buyers could concentrate their buying activities to those stations free of burr. A price discount may occur for quarantined properties to cover possible inspection and cleaning costs notwithstanding the possibility of burr establishing on the property of the buyer. The cost to inspect and then hand pick infested cattle would vary considerably depending on the amount of burr involved as well as the number of stock to be treated. The cost could be in the order of $5 to $10 per beast (pers. comm,. P. Stubbs, 1996).

iii) Irrigation areas, the Ord River and Carnarvon

Should Noogoora burr spread to the Ord River Irrigation Area it would have the potential to be a weed of any future cotton growing properties. Noogoora burr would be treated as any other broadleaf weed of cotton. Noogoora burr is also likely to produce dense thickets along irrigation ditches if it was allowed to establish. Narrabri weed agronomist Graham Charles, 1996, stated that...(Noogoora) burr is a major problem in cotton, and should be kept out if possible, but it is not the most serious weed and not one I would be particularly concerned about. "*Xanthium occidentale*" (Noogoora burr), noted as the worst weed, affects 44% of the cotton area (in NSW) but is a diminishing problem due to better management practises... (G. W. Charles, 1991). ...the important weeds affect a large proportion of the cotton area but are being controlled by present weed management practices and have a stable or declining incidence (ibid).

Noogoora burr may also have the potential to become a weed in the intensive horticultural area of Carnarvon. The treatment of Noogoora burr in irrigation areas would be included in any broadleaf weed control program. It would still be beneficial to keep Noogoora burr from establishing as it would be an extra weed to have the potential to be a problem. The extra costs that may be incurred to keep Noogoora burr out of the irrigation areas are not likely to be high. An education program to encourage cotton (and other) growers to eradicate initial infestations would be very valuable, but I don't believe a Government funded control program could be justified (pers. comm., G. Charles, 1996).

iv) Other considerations

No monetary values were estimated for either the expected loss of native species or for the adverse affect to the recreational areas along the wildlife corridor adjacent to the rivers. However one bird whose habitat is restricted to a few metres of each side of certain permanent rivers that lie within the latitudes of 14° and 19° south is worth a mention. The Kimberley sub-species of the purple-crowned fairy-wren probably numbers less than 7,000 individuals (I. Rowley, 1988). These fairy-wrens are likely to

be adversely affected by Noogoora burr proliferation reducing the number of insects within 50 metres of the rivers which is their food supply.

Previous benefit cost analysis on the Noogoora burr control project

In Roberts *et al*'s Summary the control program is said to be economically justified if Noogoora burr was to spread to the southern rangeland but not the eastern goldfields and contaminate 50% of the total sheep flock without the control project. It was also economically justified if Noogoora burr was to spread to the southern rangeland and the eastern goldfields and contaminate 25% of the sheep flock without the control project.

These estimates seem to be high considering the experience of the eastern states. Even in the areas of the eastern states where Noogoora burr is at its worst the highest level of recorded contamination is 9% (Wapshere, 1974). More generally contamination is in the range of 3 to 9% (see Figure 1). These eastern states' areas are also more climatically suited to the growth of Noogoora burr as they provide greater opportunities for the burr to have access to water during summer. As well as higher summer rainfall there are more river systems to provide ideal growing situations for the burr. Flooding of these river systems provides a mechanism for the burr to spread to the floodout areas increasing the opportunity for sheep to become contaminated.

Secondly the control costs have increased more than was predicted. The control costs in 1985 were $260,000 (including $60,000 overhead costs) equivalent to $420,000 in today's dollars. This is much less than what it cost to carry out a much more extensive control project in 1995/96 ($800,000 also including overhead costs). This increase in costs, due to the bigger control program and the availability of funds, was far more than was anticipated then and therefore meant that the benefit cost analyses suggested more favourable results than actually occurred. The penalty used in the 1985 study for burr contamination of the wool was 20 cents per kg which converts to about 32 cents today which is within the range of this study. Their assumed cut per head of 4 kg was slightly lower than the 4.5 kg used here but this difference would have much less affect than the price penalty and the percentage of wool infested.

If all work on Noogoora burr was terminated and there was no government involvement in stock inspections Noogoora burr is unlikely to create a blanket cover of tens of thousands of hectares as occurs in the Kimberley in the southern rangeland and even less likely to proliferate in the eastern goldfields other than close to water points. The southern rangeland and the eastern goldfields, even more so, are much drier than required by Noogoora burr to flourish. The rivers only flow periodically and would not provide a permanent summer moisture supply to encourage Noogoora burr growth. Similarly there is not a great potential for Noogoora burr to be a significant weed of the Western Australian wheatbelt. It would only grow near watering points (pers. comm., R. Martin, 1996). Noogoora burr has an obligatory photoperiod requirement for flowering - so in the absence of follow-up rain it dies without flowering or produces very little seed. Thus control should be quite easy provided outbreaks are known and are accessible (pers. comm., R. Martin, 1996).

Noogoora burr would be unlikely to cause a 25% contamination let alone a 50% contamination as used in the Roberts *et al* analysis. Except where burr spreads from widespread flooding pastoralists would be able to keep burr free by not buying infested stock or machinery. Also where infestations are located early, containment projects would be worthwhile. Infestations arising from burr transported with camping equipment, fishing gear or caravans and other campers are unlikely to occur on all pastoral stations. When they do occur the infestations will be limited in extent so that they would only affect parts of stations. Consequently not all of the station's sheep will be contaminated on those stations that have infestations. A majority of the stations would be expected to remain free of Noogoora burr.

A Noogoora burr free southern pastoral zone is dependent on the border checkpoints as well as the Kimberley control project, Kimberley stock inspections and an extension campaign

Stock inspections at Norseman and Parkeston have ensured that any burr infested animals entering the south-west have been either hand-picked or shorn. The combined effect with the Noogoora burr project in the Kimberley has enabled the sheep areas to remain free of Noogoora burr. Noogoora burr remains extensive in the eastern states, in particular, northern NSW and Queensland and is also present in Victoria and South Australia but has not colonised the sheep areas of WA. It is a similar approach to that occurring with stock entering WA from the east. The inspection system for stock moving south from the Kimberley is most important.

It would be logical to treat the infestations in the Kimberley and the eastern states in the same way. Stock entering WA from the east must be accompanied by a freedom of declared plant declaration signed by a government inspector. The stock should also originate from a Noogoora burr free property, although in practise this condition is often overlooked.

Results of Benefit Cost Analysis (BCA)

The results were derived from the Pest Control Evaluation Spreadsheet (PCES). The evaluation was carried out for the 1996/97 program (see Table 2). The revised control costs for 1996/97 have been set at $341,150.

With the $341,000 control project (at the 1996/97 level)

- A limited amount of sheep (17,000) in the southern rangeland will become contaminated and will incur wool fault. The expected number of sheep affected was determined by the assumption that there was a 0.2 probability that 25,000 would be affected, a 0.4 probability that 20,000 sheep would be affected and a 0.4 probability that only 10,000 sheep would be affected.
- Approximately 17,000 ha (at $4.50 per ha) of Kimberley river country will be lost to cattle grazing. The expected loss of Kimberley grazing country was determined by the assumption that there was a 0.4 probability that 10,000 ha would be affected, a 0.5 probability that 20,000 ha would be affected and a 0.1 probability that up to 30,000 ha would be affected.

Table 2
BCA for the 1996/97 Control Strategy (Annual cost $340,000) over 30 years

Benefit cost ratio (BCR):	1.2:1
Present value of net benefits:	$680,000
Present value of benefits:	$4.3 million
Present value of costs:	$3.6 million
Internal rate of return:	11%

Results were also developed for the project as it stood for 1995/96 when the control costs were approximately $800,000 (see Table 3). With this level of control it was expected that there would be no contamination of sheep in the southern rangeland and there would be no loss of Kimberley grazing country.

Table 3
BCA for the 1995/96 Control Strategy (Annual cost $800,000) over 30 years

Benefit cost ratio (BCR):	0.5:1
Present value of net benefits:	-$4.9 million
Present value of benefits:	$4.3 million
Present value of costs:	$9.2 million
Internal rate of return:	Not applicable

Key assumptions

With the $800,000 control project (at the 1995/96 level)

- The project minimises the possibility of Noogoora burr from the Kimberley establishing in any of the sheep grazing areas of WA, i.e. all stock and machinery movements and fodder movements to areas where the plant could contaminate the wool clip, if they occur in the future, will be inspected for burr.
- No Kimberley grazing country is lost to Noogoora burr.

Without a Government conducted control project

The uncontrolled Noogoora burr would spread from the Kimberley and establish over the southern pastoral sheep grazing areas. The burr would not establish in the wheat/sheep belt to the extent where Noogoora burr fault occurred but could in the south-west grazing areas along irrigation channels. Only a minimal, if any, Noogoora burr fault would occur in the south-west or the wheat/sheep belt.

- There would be an expected loss of 40,000 ha of Kimberley river grazing country valued at $4.50 per ha due to the spread of the burr displacing pasture species. The expected loss of Kimberley grazing country was determined by the assumption that there was a 0.2 probability that 20,000 ha would be affected, a 0.6 probability that 40,000 ha would be affected and a 0.2 probability that up to 60,000 ha would be affected.
- In the pastoral areas there would be a twenty per cent probability that one million sheep would be affected, a forty per cent probability that 500,000 sheep would be

affected and a further forty per cent probability that 250,000 sheep would be affected.

- The effect would be a 50 cents per kilogram deduction for burr infestation with an average cut of 4.5 kgs per sheep, totalling $2.25 per sheep.
- The cut-off date for the analysis was 2026 which was also the time estimated for the burr to cover its expected range.
- A discount rate of 8% was used.
- $50,000 would be spent annually to treat infestations of Noogoora burr as they occurred in the southern rangeland, the wheat sheep belt and the south-west.

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